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INTRAOCULAR AMMETROPIA CORRECTION PHAKIC LENSES (LITERATURE Review)

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Abstract
Refractive error of the eye is the most common pathology of the organ of vision. The prevalence of this pathology among the general population is, according to various authors, from 12 to 80%. Such a scatter in the frequency of occurrence is associated with regions of residence and age scatter during the analysis. The traditional way to correct refractive errors is spectacle correction. Currently, more than a billion people in the world use glasses to improve their visual functions. An alternative to spectacle correction is contact correction. It is also one of the most widespread types of correction of refractive errors in the eye.

Keywords: surgical correction, ametropia, insufficient thickness, cornea.

Introduction

However, not in all cases glasses and contact lenses fully satisfy patients. This is due to intolerance to the correction, the impossibility of their use associated with environmental conditions and labor activity, cosmetic dissatisfaction and other circumstances. In such cases, surgical types of correction of ametropia come to the aid of patients. The most common type of surgical correction is currently laser correction. Millions of such surgeries are performed worldwide every year. Excimer laser correction also has some limitations for their use. The most common reasons for the impossibility of using laser correction are high degrees of ametropia, insufficient thickness of the cornea. In cases where there are no conditions for the use of laser types of correction, patients can be offered methods of intraocular correction. One of the widespread types of intraocular correction of ametropias is the use of phakic intraocular lenses (PIOL). FIOL - these are lenses that are installed inside the eye while preserving the natural lens. Depending on the location, they are divided into 3 types: anterior chamber with fixation in the region of the angle of the anterior chamber, anterior chamber with fixation to the iris and posterior chamber with fixation in the ciliary sulcus or without fixation.

This procedure has a number of advantages: predictability, accurate and stable refractive effect, increased spatial contrast sensitivity, preservation of accommodation, short rehabilitation period, ease of implantation, reversibility of

intervention if necessary. In myopic patients, PIOL gives better results than laser keratoablation or extraocular correction methods, since the lens inside the eye creates a larger image on the retina and increases the maximum corrected visual acuity by an additional 1-2 lines [5] .

Most researchers [15, 11] are of the opinion that the use of PIOL is optimal for myopia over 9.0 D (up to 25 D), hypermetropia over 6.0 D, and astigmatism up to 6.0 D [21]. In this case, the depth of the anterior chamber when using anterior chamber lenses should be at least 3.0 mm, posterior chamber lenses should be at least 2.8 mm, and the density of corneal endothelial cells should be at least 2000–2500 cells /mm2 [14]. Summarizing the information available in the literature [23] , we can distinguish a group of patients for whom implantation of phakic intraocular lenses is the method of choice:

1. age from 21 to 40 years;

2.myopia more than 10 -12 diopters , without changes in the lens;

3. intolerance to spectacle and contact correction; 4. patients with insufficient corneal thickness for laser correction, high risk of developing keratectasia ;

5. patients with small corneal curvature (less than 39 diopters).

The optical power of FIOL is selected according to the recommendations of manufacturers, and can also be determined on modern biometers that have the appropriate programs (IOL Master , Lenstar LS).

A method has been proposed for indirect determination of the diameter of the ciliary sulcus based on p OCT, which ensures the correct position of the posterior chamber PIOL in the eye, which confirms the effectiveness of its use in the clinic [8] .

The PIOL implantation method is as follows: paracentesis is performed in the cornea, the anterior chamber is filled with viscoelastic , PIOL, depending on the model, is implanted in the anterior or posterior chamber of the eye, iris coloboma is performed using a vitreotome , viscoelastic is washed out and the operating approaches are sealed by hydration . A number of authors [2] propose to carry out peripheral iris colobomas before surgery using a laser to prevent hydrodynamic complications.

Conducted ultrasound biomicroscopy before surgery, immediately after surgery, 1 and 6 months after implantation of PIOL. **[10]** In 64 patients (128 eyes) with myopia (120 eyes) and hypermetropia (8 eyes) of medium and high degrees without concomitant pathology. In all cases, IPCL was implanted (Care Group , India). Results. On day 1, in 62 patients (96.8%), the depth of the anterior chamber decreased by 0.67 ± 0.1 mm, the angle of the anterior chamber was open, the profile of the iris was straight, the position of the PIOL in the ciliary sulcus, the distance between the PIOL and the lens was 0, 57±0.2 mm, ligaments of Zinn are preserved, the ciliary body is without

features, the lens is transparent. After 1 and 6 months. in 62 patients, the state of the structure of the anterior and posterior chambers did not change.

The first PIOLs were made of PMMA; their implantation required a 6–7 mm surgical access, followed by suture sealing. Such lenses are now completely banned, as they have led to serious complications such as endothelial - epithelial corneal dystrophy, iridocyclitis, secondary glaucoma, hyphema , and astigmatism. To date, the only anterior chamber PIOL with iris attachment, Artisan / Verisyse (Ophtec , Holland), which was developed by the Dutch ophthalmologist J. Worst in 1986, has been recognized and approved in the United States . The PIOL with the original name " Lobster claw lens ". The first model of the lens is a rigid monolithic structure made entirely of PMMA, with claw slits in the support part, in these slits the iris tissue is clamped, due to which the lens is kept suspended in the plane of the pupil. This lens was originally used to correct aphakia if the native lens capsule was missing, but over time it turned out to be suitable for implantation in the phakic eye [19]. Zuev V.K. [5] created the world's first Teflon-coated posterior chamber flexible silicone lens. In 1978, the authors received a patent for the original design of the posterior chamber lens of the "fungus" type, which was supported in the correct position by the edge of the pupil. The optical part of the lens is inserted into the pupillary edge of the iris, and the haptic part is located in the posterior chamber. Due to the fact that the lens is centered by the pupil, this automatically prevents its displacement. In bright light, the pupil does not narrow less than 3 mm in diameter, hence the problem of glare can arise , and when the pupil expands, the quality of vision decreases due to the presence of light, the halo effect and the lens moving off the optical axis. Later, the RSK-1 model was created, which is completely located in the rear chamber. In 1986, on the basis of MNTK "MG", a Fedorov-Zuev model of the "RSK-3" type was created, made of silicone with a Teflon coating. The lens went through modernization and began to be made from collagen, since silicone was toxic, and if the Teflon coating was broken, a progressive decrease in the density of endothelial cells developed. A hole appeared in the optical part to restore the natural outflow of intraocular fluid and prevent the effect of lens suction to the anterior surface of the lens [1]. At present, a more advanced model of posterior chamber PIOL manufactured by STAAR Surgical under the trademark ICL and some other companies is widely used. Literature review [22] showed a very high efficiency of using modern design PIOLs with a hole for fluid circulation, the use of large optical zones and the possibility of using multifocal PIOLs to correct presbyopia. Phakic IOLs have come a long way since they were first described in the 1950s. The initial postoperative complications were eliminated one by one, and modern PIOL can be considered a safe alternative in the correction of

refractive error. However, it should be noted that the excellent results usually achieved with modern PIOL designs are associated with the development of safe preoperative patient selection and increasingly accurate biometric measurements [6]. There is a positive experience of using PIOL in the practice of pediatric ophthalmology. When correcting high ametropia in children, PIOL has become a good alternative to lensectomy methods. [9] .

Japanese colleagues claim that monovision with PIOL implantation provided good binocular vision at near and far distances, without the development of cataracts, suggesting its feasibility as a new surgical presbyopic approach for early presbyopia (the lens was calculated for emmetropia in the dominant eye, and not the dominant eye – slight myopia) (monovision) [17].

An analysis of 30 literature sources published between 2003 and 2009 [22] showed that there is strong evidence for the short-term efficacy and safety of PIOL. The predictability of the operation and the achievement of high visual functions in the majority of patients (80% or more) have been proven. Analysis of long-term results (more than 10 years) shows the development of cataracts in 9.6% of cases when using posterior chamber PIOLs . With the use of FIOLs fixed to the iris, a chronic loss of endothelial cells was noted. Comparative studies have shown that PIOL provides better spectacle-corrected visual acuity, predictability and stability of refraction compared to LASIK and photorefractive keratectomy have a lower risk of retinal detachment compared to the replacement of a transparent lens with an artificial one. Particularly good results were obtained using toric PIOLs [16].

According to other researchers [19], PIOLs also demonstrate reversibility, high optical quality, and a potential increase in visual acuity in patients with myopia due to an increase in the image on the retina; correction is not limited to the thickness or topography of the cornea. Under correct anatomical conditions, PIOLs also show good results in patients with hypermetropia. Designs of toric FIOLs allow for spherical-cylindrical correction. Complications are rare and primarily related to the position and type of PIOL. The main complications of using an angle- supported anterior chamber PIOL are glare and halos, pupil ovalization , and loss of corneal endothelial cells; iris-fixed PIOLs in the anterior chamber, chronic subclinical inflammation, loss of corneal endothelial cells, and glaucoma with pupillary dislocation or blockade and with the use of posterior chamber PIOLs , anterior subcapsular cataract formation, pigment dispersion, and dislocation of PIOLs or glaucoma with pupillary blockade. A causal relationship between PIOL implantation (of any type) and retinal detachment has not been established. Sufficiently good immediate and long-term results were also

obtained with implantation of posterior chamber PIOLs of the Fedorov-Zuev RSK 3 model in high myopia [2, 12] .

In a multicentre retrospective study sponsored by the Spanish Ministry of Health [13] , a total of 240 eyes (226 patients) were explanted due to PIOL complications . Clinical data on 144 angled lenses, 24 fixed irises, and 72 explanted posterior chamber lenses were recorded before and after surgery. The average age of patients at explantation was 46.30 ± 11.84 years (from 25 to 80 years). The mean time between implantation and explantation was 381.14 ± 293.55 weeks (range: 0.00 to 1551.17 weeks). It was 422.33 ± 287.81 weeks for the angle support group, 488.03 ± 351.95 weeks for the iris fixation group, and 234.11 ± 4221.60 weeks for the posterior chamber group. It was 8.10 ± 5.52 years for the angle support group, 9.36 ± 6.75 years for the iris fixation group, and 4.49 ± 4.25 years for the posterior chamber group. This time period was significantly shorter in the posterior chamber group ($P < 0.001$). Overall, the main causes of explantation were cataract formation (132 eyes, 55%), endothelial cell loss (26 eyes, 10.83%), corneal decompensation (22 eyes, 9.17%), PIOL dislocation/ decentration (16 eyes, 6.67%), insufficient size or power of PIOL (12 eyes, 5%), and pupil ovalization (10 cases, 4.17%). Cataract development was the cause of explantation in 51.39% of cases with angle support, 45.83% of cases with iris fixation, and 65.28% of cases with posterior chamber. Loss of endothelial cells was the cause of explantation in 15.97% of PIOLs with angle support, 8.33 % of PIOLs with iris fixation, and 1.39% of PIOLs of the posterior chamber. **Findings.** Cataract is the main cause of PIOL explantation, especially in posterior chamber PIOL. In the angle support group, loss of endothelial cells was the second reason for explantation. Konovalov M.E. et al . also indicate the removal of PIOL in some patients 2–6 years after implantation [7]. According to the observations of other authors [18], among the most frequent late postoperative complications were pigment dispersion syndrome in 27 eyes, 43.5% (12 myopic eyes and 15 hyperopic eyes) and cataract formation. Lens opacity, including opacity without loss of BCVA, was observed in 18 eyes (29%). Opacities affecting visual acuity were observed in 10 eyes (16.1%). Cataract, which significantly affected visual acuity, occurred in 7 eyes, i.e. in 11.3% (5 eyes with myopia and 2 eyes with hypermetropia).

Thus, we can conclude that PIOLs are rapidly gaining a place in refractive surgery. And the development of refractive surgery for the near future is intraocular correction [4]. The problems associated with such operations can be considered solved to a large extent. In the near future, indications for the correction of refractive errors by IOL implantation in the phakic eye will be significantly expanded. Long-term observations indicate sufficient safety of Ophtec phakic IOL models Artisan and ArtiFlex . New

promising model - Vivarte Presbyopic (CIBA) Vision), its hallmark is multifocality , which is important for presbyopia. The most important unresolved problem in PIOL implantation remains the issue of determining lens sizes.

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